Date: May 22, 2007 | Category: Stars - Individual, Binaries, Clusters | Proposal: 2214

National Research Council of Canada, Herzberg Institute of Astrophysics
DAO 1.8-m TELESCOPE OBSERVING TIME REQUEST
Quarter: 2007C

1. Title of the Program *(may be made publicly available for accepted proposals)*:

Real Time Supernova Spectroscopic Confirmation and Spectral Library Acquisition Project

2. Principal Investigator: **Eric Hsiao**

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3. Co-Investigators:

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4. Summary of the Program *(may be made publicly available for accepted proposals)*:

The goals of the proposed project are to acquire spectroscopic confirmation and typing of newly discovered supernovae and to compile a library of supernovae spectra with good temporal coverage. We will include supernovae of all types, with preference given to type Ia.

5. Summary of the Observing Run Requested:

Instrument	Detector	Filters and/or Central Wavelengths
Spectrograph: 21(3/2)1	SITe2 - spec.	5100 Angstroms

# of nights	Contract?	Moon (d)	Opt. LST at 0:00 HST	Min. LST at 0:00 HST	Max. LST at 0:00 HST
20	NO	14	Any	Any	Any

6a. Is this a Thesis Project? YES 6b. If yes, indicate supervisor: Dr. Chris Pritchet

7. Special instrument or telescope requirements:

3 arcsecond slit width

8. Scheduling constraints and non-usable dates:

We would prefer to observe once every three nights, mostly during dark time but with at least one bright time night scheduled to ensure good temporal coverage of evolving supernova spectra.

9. Is this program conducted in relation with other observations (optical, radio, space)?

NO

10. Scientific Justification and References *(science background and objectives of the proposed observations: 1 page maximum)*:

Type Ia supernovae (SNe Ia) are classified spectroscopically from other classes of SNe by the presence of SiII and the absence of hydrogen and helium. They are a remarkably uniform class of objects, both in their light curves (e.g., Phillips et al. 1993) and in their spectral evolution (e.g., Branch et al. 1993). The uniformities have significant implications for their progenitors and make them useful tools in the direct measurements of cosmological parameters.

On average, there are about three nearby supernovae at bright enough phases of the evolution to be adequately observed. The proposed spectroscopic observation once every three nights will enable us to consistently confirm and type in real time newly discovered supernovae from the IAU Circulars and other ongoing SN surveys.

Within the Type Ia subclass, there have been discoveries of peculiar SNe Ia with vastly different spectral features. Only a decade ago, the peculiar spectra were categorized into 1991T-like and 1991bg-like objects. Branch 2001 has estimated the rate of these peculiar objects to be approximately one in five. Today, there are many peculiar objects which are neither 1991T-like nor 1991bg-like (e.g., 2000ic, 20002cx, 2005hk). The emergence of these new subclasses reflects our lack of physical understanding and offers new insights to the true nature of these objects. With our proposed intensive program, we will make particularly detailed time series spectral observations of a few of the peculiar SNe Ia.

Even within the "normal" SNe Ia, there are subtle differences in spectral features which are found to relate to different SN Ia properties (e.g., Benetti et al. 2005). New methods of quantifying the properties of spectral features (e.g., Folatelli 2004, Hsiao et al. 2007) offer new diagnostics and quantitative ways to classify the spectra. The proposed program will strengthen the statistical significance of the current spectral library where gaps in many wavelength and temporal regions still exist.

SNe Ia have so far been treated as a one parameter family. The light-curve widths of SNe Ia is directly related to its peak brightness (Phillips 1993). The width-brightness relation allows the reduction of the scatters on the Hubble diagram from ~ 1 to ~ 0.15 magnitude. Theoretical works (e.g., Kasen et al. 2007) have suggested that there may be a second parameter in the velocities or strengths of spectral features. With expanded samples of observed spectra and new diagnostic tools, we will be able to search for a second parameter in the spectral features and possibly offer new empirical methods to further improve the use of SNe Ia as standard candles.

With the advent of large dedicated SN Ia cosmology surveys, the error budgets of the peak magnitude have been pushed toward the 10 per cent level. K-corrections then became one of the dominant error contributors in SN Ia cosmology (Hsiao et al. 2007). The errors on the peak magnitude of a SN Ia should be lowered with more observations at different epochs. If the errors are completely uncorrelated, the final error on peak magnitude would be approximately reduced by $1/\sqrt{N}$. On the other hand, if the K-correction errors are perfectly correlated, there would be no reduction in error. In reality, we expect that the errors are between the extremes and are partially correlated. At present, the correlations between errors at different epochs are poorly understood due to the lack of time series spectral observations of local SNe Ia. The proposed time intensive spectral observations will provide valuable data for this cosmological analysis.

References

Benetti, S., et al. 2005, ApJ, 623, 1011
Branch, D., Fisher, A., & Nugent, P. 1993, AJ, 106, 2383
Branch, D. 2001, PASP, 113, 169
Folatelli, G. 2004, Ph.D. thesis, Stockholm University
Hsiao, E. Y., et al. 2007, ApJ, in press (arXiv:astro-ph/0703529)
Kasen, D., & Woosley, S. E. 2007, ApJ, 656, 661
Phillips, M. M. 1993, ApJ, 413, L105

14. Targets:

Object/Field	α	δ	Epoch	Mag/Flux	Comment

13. General Target Information:

As supernovae are transient, targets will be selected from available lists of exploding supernovae such as IAU circulars and supernova detection surveys. Generally, from these sources, there are 2 to 3 candidate SN with sufficient magnitudes to observe at any given time.

14. Publications Resulting from DAO Observations *(only the 12 most recent contained in the database are displayed)*:

Iwamoto, Koichi; Nakamura, Takayoshi; Nomoto, Ken'ichi; Mazzali, Paolo A.; Danziger, I. John; Garnavich, Peter; Kirshner, Robert; Jha, Saurabh; Balam, David; Thorstensen, John 2000, ApJ, 534, 660

Hurst, G. M.; Boles, T.; Armstrong, M.; Benetti, S.; Ghinassi, F.; Marchetti, E.; Tessicini, G.; Vuerli, C.; Zacchei, A.; Balam, D.; Sano, Y.; Yamaoka, H. 1998, IAU Circ., 7033, 1

Yamaoka, H.; Kato, T.; Filippenko, A. V.; van Dyk, S. D.; Yamamoto, M.; Balam, D.; Hornoch, K.; Plsek, M. 1998, IAU Circ., 6859, 1

Disclaimer: *In submitting this application, I acknowledge that I am aware of DAO's policy concerning public access to data after a proprietary period of one year.*

Signature: signed via "POOPSY"